ASM INTERNATIONAL

Bangalore Chapter – News Letter

Issue 4 : February 2021

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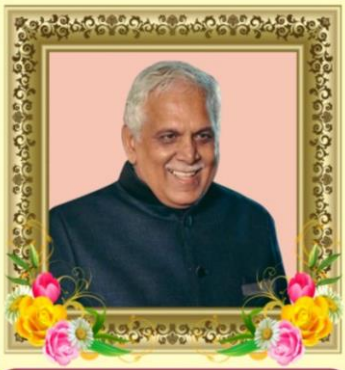
Chairman's Message



The release of this issue of our newsletter coincided with the sudden and unexpected demise of a very Dear and Dedicated leader of ASM in India, Trustee of ASM international, Mr Prem Aurora. He was known to all of the regular members in any of the chapters in India. Premji, as he was fondly called, was a pleasant presence at almost all the ASM events of national significance, motivating, guiding and egging chapter leaders to contribute their maximum to the cause of ASM. He was always available, almost round the clock for any assistance we needed and most happy to help us out. He was the one who, from time to time, reminded us of our obligations to HQ and at the same time put forward the needs of members/chapters in India to the HQ. For me, presently, there could be no bigger loss to ASM, especially in India, than him leaving, in spite of our Prayers for his recovery, ever since we came to know of his Ailment. His death is a grim reminder to all of us who may feel that normalcy has returned, to do all we can to arrest this pandemic knocking at our doors.

A worthy tribute to Dear Premji's memory would be that ASM in India, with its constituents, continue with his zeal, the great work which has brought us to where we are.

Rahul Masurekar

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About ASM International

ASM International formerly known as the American Society for Metals was established in 1913 as a professional body of heat treaters. It has since evolved as an international professional body of material scientists, engineers, R&D professionals and academicians with the motto of collecting &disseminating knowledge on Materials and Processes. The worldwide network of more than 38,000 individuals is led by members, guided by members' needs and fueled by members' participation.

About ASM Bangalore Chapter

ASM Bangalore chapter is actively involved in dissemination of materials centric knowledge among working professionals, researches and academicians. ASM Bangalore chapter began its activities in the year 2006. Since then it has dedicated itself in spreading information based on materials among various stakeholders. Bangalore is a strategic center for several major automotive, aerospace, defense & R&D institutes and thousands of engineering professionals and it is imperative to educate & connecting the community in the field of Metals & Material science Technology. Under the able leadership of present chairman Mr. Rahul Masurekar – a well-known Industrialist and capable office bearers, ASM Bangalore chapter is gaining wide popularity by activity involving and supporting the technological up-gradation of Engineering community.

The Prime objectives of ASM Bangalore Chapter are

1. To disseminate materials centric information among professionals by organizing seminars, lectures, One/two days' workshops
2. To bring together Scientists, Intellectuals and Professionals working in the field of materials science to exchange ideas/knowledge/information.
3. To encourage and support student chapters among various Engineering colleges in the state of Karnataka and enlighten them, the importance of materials properties, selection and its application.
4. To Promote consultancy services by ASM members to solve industry problems in the area of materials.
5. To recognize and award ASM members for their contributions to field of materials science.

ASM Bangalore chapter has members with rich expertise and professional experience with deep insight to practical applications in the field of materials science & engineering. ASM Bangalore chapter offers consultancy in the broad areas of Material selection &Characterization, foundry practices, mechanical testing, forging, heat-treatment, failure analysis, Corrosion control, Nondestructive Evaluation (NDE), process simulation to name a few.

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Or Call Membership Chair – Mr. Krishnadas Nair – 8879233440

Or write ASM Bangalore Chapter asmblr2015@gmail.com

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Featured Articles:

"Tools subjected to abrasion and impact - some considerations for material selection"

- Mr. Manohar Hegde

Synopsis: Tools used in equipment employed in transportation, earthmoving and mining industries experience high levels of abrasion, force and impact. Consequently, these tools undergo significant levels of wear and material destruction during service. When the tool life falls short of the estimated life it may have serious implications on safety and commercial viability of the industry. Thus, selection of materials for these tools plays major role in their performance. Four case studies have been selected representing different application profiles, to explain how tool material is selected. First example (Railway brake block) experiences only abrasion, and no impact, whereas the last example (Rock breaker chisel) experiences mainly impact and virtually no abrasion. Remaining two examples show a medley of abrasion, high force and impact. Their typical applications, generally used materials for the tools, commonly experienced failure modes, and continuing research trend to improve the tool performance is discussed.

Background:

Primary consideration for selection of material for any component is its suitability to fulfil the intended function under all usage conditions. Properties of the material are matched to the requirement of the usage conditions. Mechanical work tools used in industry are subjected to varied levels of force, abrasion, impact, etc. Additionally, environmental effects like corrosion will also affect them. A vast majority of the metals, and their alloys, used in industry today are selected on the basis of material mechanical properties like strength, density, Young's modulus, and probably hardness. In addition, some applications may require specific levels of additional qualities like toughness in the material. Applications experiencing heavy abrasion, force /torque and impact are such examples.

Since these tools are considered as consumables, other than the performance considerations, the economics of usage of these tools are important while selecting the material.

Generally, steels having higher strength, higher hardness and higher toughness are always preferred for these applications. The basic material specifications have been well established over a period of

time, especially in industries like mining, construction, steel making, transportation, etc., where abrasion resistance, impact resistance are primary requirement. Although it is well known that, by adding elements like chromium, nickel, molybdenum, vanadium, etc., steel with optimum quality can be achieved, development of such new material is time consuming and research is expensive. Hence there is a tendency to stick to well established standard materials.

There are two aspects which inhibit manufacturers going for such specialized alloys: 1. Higher cost due to addition of these expensive elements. 2: Complex manufacturing processes, especially heat treatment, to achieve the desired properties in the material.

Hence, it is always a trade-off between higher cost of manufacturing but better performance on one hand, and lower procurement cost but frequent replacement on the other.

Nevertheless, manufacturers continue to invest in developing new cost effective alloys, and optimize them to get incremental benefits in performance and cost. Development of new material specification requires active participation of end users, and often it is carried out as collaborative projects, in which both the manufacturer and end user gets benefitted.

The following examples, in which the tools are subjected to different levels of abrasion, force and impact under differing working conditions and applications, explain how the selection is fine-tuned :

a) Railway brake block - abrasion, high shear and compressive force.
b) Ground Engagement Tools(GET) – high force, abrasion and impact.
c) Stone crusher jaw plate – high impact, abrasion and compressive force.
d) Impact hammer chisel - very high and repeated impact.

Railway Brake Block: They are used to transfer force from application mechanism to the rotating railway wheels during braking. Brake is the most safety critical system a moving train. The primary objective of the brake mechanism is to produce a frictional torque opposing the wheel rotation. The frictional coefficient between the wheel tread and brake shoe determines the quantum of frictional torque developed. Higher the co-efficient, better the braking effectiveness. 'Shoe pressing on the wheel tread' design was adapted for the Railway brakes from the very beginning. The brake shoe has to withstand the high compressive and shear forces developed during braking. In addition, it should have ability to withstand temperature rise during braking, maintain constant frictional coefficient and dimensional stability over time. Also, it should be easy to machine. Grey cast iron was the chosen material for brake block because of it's familiarity to the engineers. It also met all the above requirements satisfactorily, as long as the train speeds were less than 120 kmph. However, as the train speeds increased, certain drawbacks of cast iron as a shoe material came to light, like higher wear rate, excessive noise, sparking tendency during braking, etc. Over the years, train speeds are increasing continually and to make the trains stop quickly requires higher levels of co-efficient of friction. Cast iron brake block - steel wheel combination cannot develop a consistent dynamic coefficient of friction above 0.2 Although adaptation of disc brake and use of non-metallic composite material shoes were tried out to overcome the shortcomings of cast iron shoe brakes, high cost of adaptation (disc brake) and inconsistent properties (non-metallic composite shoes) have prevented the universal acceptance of the alternative options. Hence, research has been going on to overcome the deficiencies of cast iron as a shoe material. Phosphorous content in the cast iron material was found to be beneficial in reducing the shoe wear, noise, as well as reducing the possibility of sparking. So, in spite of the known

detrimental effects of phosphorous content in cast iron, phosphoric cast iron was adapted in railway brakes. At the moment, researchers are concentrating on achieving higher coefficient of friction and higher wear life with cast iron brake blocks even at speeds exceeding 120kmph. Austempered and compacted graphite irons with higher phosphorous content are being actively investigated to achieve the above goals.

	
'Shoe on Wheel Tread' Type Railway Brake	A Typical Cast Iron Brake Shoe

Ground Engagement Tools (GET) : Earthmoving and construction equipment like hydraulic excavator, dozer, wheeled loader, etc.,are required to handle soft soil, sand, chemicals, mineral ore, hard rock, crushed stone material etc., during their operation. To accomplish this task they are fitted with Ground Engagement Tools (GET). Common examples of GETs are-excavator bucket tooth, bucket cutting edge, dozer lip, etc. These tools are subjected to combined effects of high force, abrasion and impact depending upon the type of material and job they handle. Their failure modes mainly manifest in premature wear, chipping-off and total breakage of the tool. The main qualities required in the material used for these tools are – good hardness, adequate toughness, and high static / fatigue strength. Since these equipment are generally used in field, the tools should have good weldability also, so that they can be easily repaired and reconstructed. These equipment handle a variety of materials, and the interaction of GETs with each of these material is unique, sometimes requiring soil mechanics approach for complete understanding. One single tool material may not fulfil the requirement of low cost, easy availability, good performance, long life and easy serviceability. Accordingly, different material may have to be selected for a GET for each type of application. The choices of material available for GETs are – cast Iron, austempered ductile iron, cast steel, manganese iron, forged alloy steel, forged low carbon steel, etc. In addition, various types of coatings/hard facings are also available.

Manganese steel has a tendency to work harden, and this property is used beneficially to protect the tooth point against chipping off or breaking. This has made this material the preferred choice for GETs for certain applications (like re-handling crushed rock, debris, etc). On the flip side, it is very difficult to machine this steel. So, the part has to be cast in the final form of usage. Cast GETs are in general more cost effective due to mass manufacturing. However, cast steel parts fall short of expectation when working on hard rocky terrain, which requires the GETs to exert very high breakout and penetration

forces. Forged ground engagement tools, due to their superior fatigue strength, are preferred for such applications. Steel, when alloyed with elements like chromium, nickel, molybdenum, tungsten, vanadium, titanium, niobium, etc., and subjected to appropriate heat treatment, can give exceptional benefits. Their high cost is justified when the applications require such a performance. Where the material handled is loose and without any hard substance (powdered ore, sand, overburden soil, etc), surface erosion phenomenon is predominant, and in such cases GETs made of low cost material and hard faced / coated can be used with much benefit.

Since the job handled by the GETs are varied and a number of material choices are available for these tools the users have to first study the application guidelines provided by the GET suppliers, and then carry out carefully monitored trials. This will help them to customize and standardize the GETs for each application. Knowledgeable users can even take into account detailed technical specification and metallurgy of each GET while conducting such trials and obtain considerable commercial benefits.

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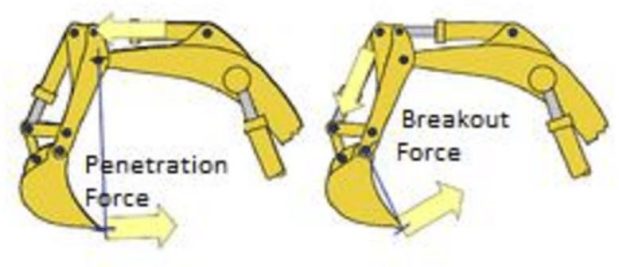
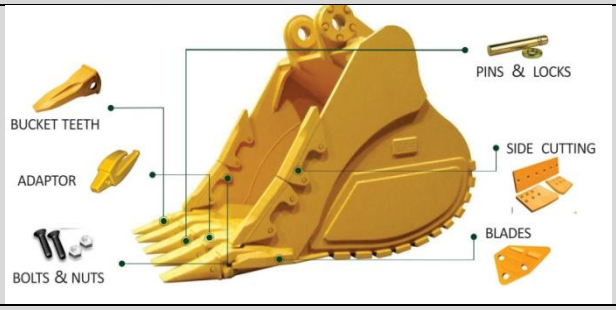
<tr><td>Hydraulic Excavator</td><td>Wheeled Loader</td></tr>
<tr><td> 
</td><td> 
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<tr><td>Forces Coming on The Bucket Teeth</td><td>Ground Engagement Tools(GETs) on a Bucket</td></tr>
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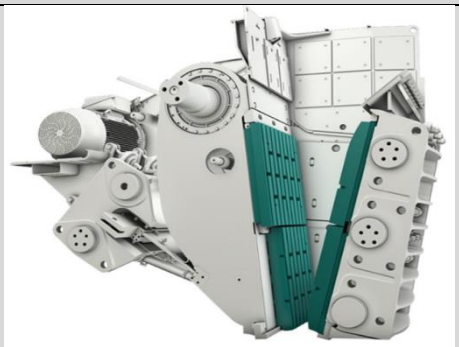
Stone Crusher Jaw Plate: Jaw plates are used in jaw crushers, where hard aggregates coming in between two such plates get broken into smaller pieces. The material being crushed are varied – mineral aggregates, hard stones from quarries, lime stone, concrete rubble, etc., and so are their properties. To make the crusher operation economical crushing needs to be carried out in a most efficient and cost effective way. So, the jaw plate material has to be selected keeping in mind the properties of the material being crushed.

The plate experiences high impact and abrasion during the crushing action. The abrasion mechanism is described as ‘Gouging abrasion’. The most popular choice of material for the jaw plate has been manganese steel, mainly due to it’s work hardening property. But the commonly available variety of manganese steel, the Hadfield steel, is almost non- machinable . So, almost always these plates are used

in as-cast condition, or, with very little machining. Researchers are working on improving the machinability by altering the alloy composition and heat treatment methods, without compromising on it's work hardening property. Parallelly, more efficient machining methods are also being developed by manufacturing engineers. Similarly, better and more economical hard facing methods are being developed to refurbish worn-out jaw plates.

	
Stone Crusher Equipment	**Jaw Plate**
	
Wornout Jaw Plate	**Jaw Plate After Re-furbishment**

Impact Hammer Chisel : A chisel is fitted to a hydraulic rock breaker (typically on a hydraulic excavator) and is used to break hard material like rocks, concrete, etc, by repeated impacts. It undergoes very high stress due to these impacts, but experiences very little abrasion. The main concern for the user is very low life of the tool. In these chisels, failure modes manifest mainly in two ways - chipping off, and bulging or going out of shape. The force of impact on the chisel is unidirectional and the abrasion is limited only to the tip. A good hardness is needed at the tip so that the chisel can break the hard substance. The chisel should be very tough also so that the chisel will not fail due to breakage, chipping-off, fatigue etc. So, a good balance between core hardness and surface hardness needs to be maintained. Chromium molybdenum alloy steel, and ASTM A681 S-7 tool steel are some of the popular material options. (Although high manganese steel also can be used, due to the difficulty of machining it is not preferred). Chisel manufacturers have been trying to attain as high a toughness as possible, without sacrificing the hardness. Even though smaller chisels could be manufactured and heat treated to achieve good overall hardness, chisels with bigger sections used in big machines, like 150mm diameter or more, could not be easily processed. The latest inventions have concentrated on achieving required balance between abrasion resistance and breakage resistance by improving the quenching and tempering methodology. Consistent impact energy values of 80 J/sq cm VNC and above have been claimed by inventors.

	
Rock breaker Impact Hammer in Action	Typical Rock breaker Chisels

The application, qualities required in the tool material, commonly used tool materials and their specification, and the development trends pertaining to the above tools have been summarised in the table below:

Sl No	Tool	Application	Desirable qualities in the material	Commonly used material (specification/standard)	Development trend (inventions / innovations)
1	Railway brake block (C.I.)	Friction brake. Generates surface tangential force due to friction(predictable usage pattern and force magnitude)	1. High compressive strength. 2. High wear resistance 3. Low sparking tendency 4. Stable coefficient of friction.	· Phosphoric cast iron : UIC 832 , PU10 and PU14(197 to 255 BHN) · RDSO : M&C/ MTD/ 101 / 2013 (draft) : 197-240 BHN	· Austempered and compacted graphite cast iron with higher phosphorous content to achieve better wear life and lower sparking tendency.
2	Ground Engagement Tools (GET)	Digging / re-handling. Experiences abrasion, high forces and impact (highly random)	1. High tensile strength. 2. High wear resistance 3. High toughness	· Austenitic manganese steel (for hard, rocky material work) : IS 276 (grade 5) 229 BHN max. ASTM A128 (grades A to E 250 initial BHN) · Abrasion resistant white cast iron(for	· Patent : US 2008/ 0066351A1- 'Metallurgically bonded coating for better wear life'. · Patent : WO 2017/070273 A1 'High manganese steel with

				sandy and abrasive material work): IS 4771 (type 1,2 and3) 400 - 600 BHN ASTM A532 (class I,II and II) 550-650 BHN · Forged steel : (for very tough terrain requiring high pulling forces) 48-52 HRC · Austempered Ductile Iron : ASTM A536	enhanced wear and impact characteristics'.
3	Stone crusher jaw plate	Crushing and powdering hard aggregates. Experiences high level of random impact.	1. High toughness. 2. Work hardening to resist gouging abrasion 3. Weldability	· Austenitic manganese steel(for crushing harder ,bigger aggregates): IS 276 (Grades 1 to 5) 229 BHN max. ASTM A 128 (grades A to E 250 initial BHN) · Abrasion resistant white cast iron(for crushing less hard,smaller aggregates): IS 4771 (type 1,2 and 3) 400 - 600 BHN. ASTM A532, BS4844 (classes I,II and III) 550-650 BHN.	· Composite design jaw plates : ASTM A532 white iron plate combined with mild steel backing plate. · Ni-hard white iron for low impact high abrasion. · Hardfacing technologies.
4	Impact hammer chisel	Breaking of hard aggregates like stone and concrete blocks. Experiences heavy repeated impact.	1. High tensile strength. 2. Higher core hardness 3. High toughness / fatigue strength	· ASTM A 681 S7 tool steel 52-58 HRC. · 40CrMo, 42CrMo tool steel 32-38 HRC.	· Patent : US 2018 / 0087137 A1 'Chisel and steel for chisel'. · Patent : JP2927694B2 'Tough wear-resistant steel with excellent breakage resistance'. · Deep cryogenic treatment 42CrMo with improved heat treatment

Conclusion : Today, a variety of metals and alloys are being developed targeting the industry. Similarly, new heat treatment and coating processes are being discovered. Users who want to get the benefit of these new materials and processes need to study the technical information available, and carry out carefully planned trials on their chosen applications, and standardise. They need to work very closely with the raw material suppliers, tool manufacturers and heat treatment agencies to execute these trials so that reliable and commercially beneficial results can be obtained.

About the Author: Dr. Manohar Hegde

He obtained M. E. degree from Indian institute of Science, Bengaluru, and worked in various industries for 3 decades. He is currently working as an independent consultant for various industries, in the areas of mechanical system design and manufacturing.

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"Nanomaterials: A Potential and Handy Solution for COVID Pandemic"

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Abstract

The ongoing COVID-19 outbreak has created awareness regarding the spread of infection, effective diagnosis and its treatment. The infection is transmitted both directly i.e., from one person to other and indirectly through contaminated surfaces. Various antiviral agents have been explored for imparting antiviral properties to the surfaces which could, thus, reduce the transmission of the viruses. Nanoparticles have been explored for not only imparting antiviral properties to the surfaces but also for efficient diagnosis and effective treatment of various viral infections. In this review, the application of different nanomaterials as antiviral agents has been discussed.

1. Introduction

There has been an outbreak of various infectious viral diseases recently. These viral diseases have accounted for almost one-third of the 20% of global mortality occurring due to infectious diseases. Examples of such viral diseases are Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), Ebola virus disease and Avian influenza A and Coronavirus disease (COVID-19). COVID-19, being highly contagious, has recently posed a serious threat to mankind. COVID-19 is caused by the novel strain SARS-CoV-2 (severe acute respiratory syndrome coronavirus-2). This virus is also named as 2019 novel coronavirus (2019-nCoV) and human coronavirus 2019 (HCoV-19). It is a spiked, enveloped, single stranded RNA virus which is highly contagious to humans. It consists of 4 types of proteins- nucleocapsid protein (N), membrane glycoprotein (M), envelop protein (E) and spike protein (S), as shown in Figure 1. SARS-CoV-2 virion has a diameter in the range of 60-140 nm [1], with spikes ranging from 6 to 12 nm. The spikes help the virus in attaching with the host cell. SARS-CoV-2 is reported to cause serious pneumonia and severe damage to the lungs in infected persons [2].

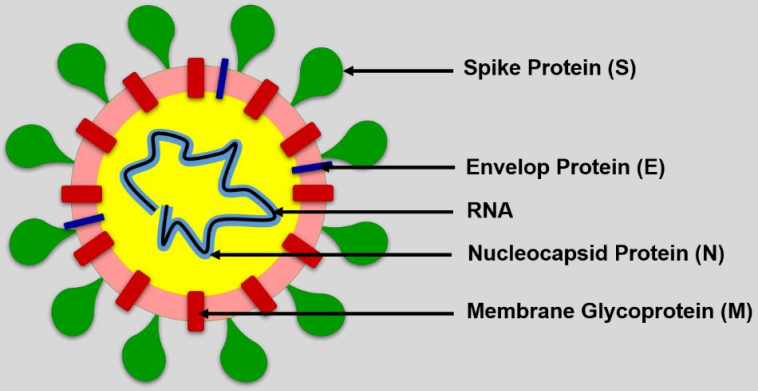

Figure 1. Schematic representation of SARS-COV-2

The severity of COVID-19 contamination and its serious threat to human health has fuelled a global requirement for effective diagnosis, treatment and mitigation of the spread of viral infection. It has also created awareness regarding the use of best practices to avoid the spread of viral infection. Since the beginning of COVID-19, researchers all over the world have been working on the development of vaccines for SARS-COV-2. Some of the vaccines have already been given approval for their usage. Examples of such vaccines are Comirnaty from Pfizer and BioNTech; Moderna COVID-19 Vaccine (mRNA-1273) from Moderna, BARDA, NIAID, US; Sputnik V from Gamaleya Research Institute, Acellena Contract Drug Research and Development, Russia; Covaxin from Bharat Biotech, ICMR, India [3] and Covishield from Oxford-AstraZeneca vaccine, being manufactured by the Serum Institute of India. Besides diagnosis and treatment of COVID-19, the other highly considered approach is of reducing the transmission of infection by making most of the surfaces antiviral in nature. Healthcare workers are supposed to be at high risk due to continuous exposure of their PPEs with the infection. A lot of research has recently been carried out to coat the surfaces of fabrics and other common utilities with antiviral coatings, so that the transmission of viruses could be avoided [4].

2. Nanomaterials as antiviral agents

Nanoparticles, due to their unique features, have attracted attention of scientists for a long time. The antibacterial properties of various nanoparticles such as silver nanoparticles, titania nanoparticles and zinc oxide nanoparticles etc. have been widely explored. However, the antiviral properties of nanoparticles have been studied to a limited extent and there is a wide area of research still available in this zone. In the current pandemic situation, several nanoparticles have given hope to the researchers to mitigate the transmission of virus using these nanoparticles [5]. The existing antiviral technologies could be differentiated into 4 major categories: polymeric nanoparticles, self-assembled nanoparticles, carbon-based nanoparticles and inorganic nanoparticles.

2.1 Polymeric nanomaterials

A wide range of polymers and polymeric nanomaterials have been investigated for antiviral compositions. Polymers such as polyethyleneimine, chitosan and chitosan sulphate derivatives have been explored for antibacterial activity and antiviral effects against different viruses such as Influenza A, Influenza B, Alfalfa Mosaic virus, Bean Goldish Mosaic virus, Tobacco Mosaic virus, Tobacco Necrosis virus and some other plant viruses. Quaternary ammonium salts and silanes have also been studied extensively for different viruses including human coronavirus. There are over 350 products on EPA's List N: Disinfectants for use against SARS-CoV-2. More than 140 chemicals are reported to deactivate the virus in just a few minutes. CYLATE T20-19, N9 XTS-18, Healthguard AMIC are some of the commercially available antiviral agents which are based on quaternary ammonium silane or quaternary ammonium salts. Similarly, polymeric nanoparticles are also promising materials to be used against viral infections since they can be engineered to reach exact targets (extracellular or intracellular) and block virus attachment to host cell receptors.

2.2 Self-assembled nanomaterials

Self-assembled nanomaterials are used mainly to deliver the functional molecule only at the target site of the microorganisms and hence, leading to optimal loading of the active molecules with maximum performance. Annette E. LaBauve et al. reported the use of self-assembled lipid coated-mesoporous silica nanoparticles for the delivery of a chemical inhibitor ML336 against Venezuelan equine encephalitis virus, which is a potential bioterrorism agent. The liposome could hold the drug effectively whereas the mesoporous silica nanoparticles promote the loading of the hydrophobic drug due to its large surface area. The studies have shown the potential of the self-assembling materials as effective antiviral agents which could further be explored for emerging virus therapeutics.

2.3 Carbon-based nanomaterials

A few studies have been reported on the application of carbon dots to study the inactivation of viruses. Ting Du et al. have reported the effects of carbon dots on DNA virus, pseudorabies virus, RNA virus and respiratory syndrome virus. Carbon dots synthesized through solid phase thermal reaction were evaluated for the inhibition of virus and were observed to stimulate the IFN-α (Interferon) production which act as the antiviral agent for viral inhibition. Recently, carbon quantum dots have also been explored for antiviral inhibition effect against human coronaviruses. Triazole functionalized carbon quantum dots have been reported to interact with the S protein of 229E human coronavirus, thus, showing antiviral effect. Similarly, studies suggesting molecular interactions of fullerene-based derivatives and SARS-CoV-2 and the antiviral activity of fullerenes have also been reported.

2.4 Inorganic nanomaterials

2.4.1 Copper-based nanomaterials

Since ancient times copper is known to possess antimicrobial activity. Copper is also reported to be antiviral against various viruses such as bronchitis virus, human immunodeficiency virus type 1 (HIV-1) and covers almost all range of viruses varying from enveloped to non-enveloped, single- to double-stranded DNA and RNA viruses. Recently, research has been carried out on antiviral properties of copper nanoparticles against SARS-COV-2 and it has been observed to be highly effective for COVID-19. The combination of copper, N-acetylcysteine, colchicine and nitric oxide along with remdesivir or EIDD-2801 has been reported as a potential treatment for patients positive for SARS-CoV-2. A study has been carried out on the stability and decay rates of SARS-CoV-1 and SARS-CoV-2 in various mediums and on different substrates. Interestingly, no viruses were observed after 8 and 4 h of SARS-CoV-1 and SARS-CoV-2 exposure to copper, respectively.

2.4.2 Silver-based nanomaterials

Silver nanoparticles (with diameter < 20 nm) and silver nanowires (with diameter 60 and 400 nm) have been reported to show significant inhibitory effect against Transmissible gastroenteritis virus, a type of coronavirus which causes infection in pigs. There has been a significant effect of the size and concentration of silver nanoparticles on their inhibitory action against SARS-CoV-2. Silver nanoparticles of size up to 15 nm showed significant antiviral effect while minimal antiviral effect was obtained for particles above 15 nm. It was also reported that the silver nanoparticles at a concentration above 20 ppm showed cytotoxic effect. Hence, silver nanoparticles with size 10 nm and concentration around 2 ppm were optimized for better antiviral activity with minimal cytotoxicity.

2.4.3 Titania-based nanomaterials

Titania nanoparticles possess photocatalytic properties, which has been widely explored to study its effect on microorganisms such as bacteria, viruses, fungi, algae and protozoa. In one study, both titania colloidal solution (with diameter 4-10 nm) and titania powder (with diameter > 500 nm) were studied for their effect on inhibiting Influenza virus. Interestingly, titania colloidal solution inhibited virus under dark in contrast to titania powder which performed its action only in the presence of light. This was mainly attributed to the size of the nanoparticles. The inactivation effect of titania nanoparticles against MS2 bacteriophage with and without ambient light has also been reported in another study.

Svetlana Khaiboullina et al. have studied the photocatalytic properties of nanosized titania against HCoV-NL63 virus, which is a close genetic relative of SARS-CoV-2. These particles showed an efficient reduction of virus even in exposure time of 1 min and there was complete inactivation of the virus in 30 min exposure time.

2.4.4 Zinc-based nanomaterials

Various studies have been reported on the antiviral properties of zinc oxide nanoparticles. R. Kumar et al. have reported the interaction of zinc oxide nanoparticles with chikungunya virus and hence, its potential of becoming an antiviral drug. Surface functionalized zinc oxide nanoparticles have also been explored for the virus inhibitory potential against Herpes Simplex virus Type-I. Zinc oxide nanoparticles functionalized with chitosan and zinc oxide nanoparticles functionalized with oleic acid showed complete virus neutralization in 24 h. In a recent molecular modelling study, the hypothesis of zinc binding to various enzymes of SARS-CoV-2 and thus, showing inhibition of viral replication capability has been supported.

2.4.5 Hybrid nanomaterials

Hybrid nanomaterials are mixtures of only organic / inorganic components or mixtures of both organic and inorganic components. These particles show enhanced properties due to the synergistic effect. Silver-chitosan composites have been explored for their antiviral activity against H1N1 (Human influenza A) virus. Silver nanocluster/silica composite coated as a film (< 200 nm size) on a non-woven fabric mask has been reported to show good antiviral activity against SARS-CoV-2. Hybrid CuxO/TiO2 nanocomposites have been coated onto paper sheets and the antiviral property has been assayed against the bacteriophage, Q-beta. It is noteworthy to mention that Naka Corporation, Tokyo Japan has commercialized this CuxO/TiO2 nanocomposites. Gold/silver hybrid nanorods have also been investigated for its antiviral activity against porcine epidemic diarrhoea virus and have shown to exhibit long term inhibition of the replication cycle.

3. Applications

COVID-19 pandemic has created awareness regarding the use of protective products for improved well-being. Since SARS-COV-2 possesses high transmissibility, it could get transferred from an infected person to other person through garments, PPEs, shoes and other surfaces which could be the point of contact. Textiles treated with antiviral agents can play a vital role in protecting us from different viruses including human coronavirus. Antiviral textile finishes have recently been explored extensively for application in different segments such as masks, coverall, gloves, bed spreads, apparels, towels etc. The antiviral finishes are generally applied on textiles via. different methods such as coating, padding, exhaustion, spray, garment wash, saturation etc. Besides textiles, the antiviral materials are also used for surface antiviral coating, surface antiviral spray, hand sanitizer, antiviral garment spray/shoe spray for retail market and air/water filtration media.

4. Antiviral test methods

The virucidal activity of different antiviral agents could be measured by different methods depending upon the final product form. It could be measured either in the liquid suspension form or on the antiviral immobilized solid substrate (non-porous or porous substrate). ASTM E1052 is generally used for evaluating antiviral activity of products in liquid form. ISO 18184 is used to determine the antiviral activity of textile products against specified viruses. ISO 21702 evaluates the antiviral activity of plastics and other non-porous surfaces like coating, ceramics, natural and artificial leathers, rubbers etc.

Conclusion

COVID-19 has created a havoc globally. In spite of showing a low mortality rate, the viral infection has claimed a lot of lives owing to its high transmission capabilities. The aim of this review is to understand the role of nanotechnology in combating the challenges of COVID-19. Ranging from their role in effective diagnosis of infection to potential treatment using nanoparticles in drug delivery,

nanomaterials have offered a ray of hope to the researchers for overcoming this pandemic. Various nanoparticles have been explored for their antiviral activity against SARS-COV-2. These nanoparticles could be coated on the surface of various substrates such as textiles, PPEs, shoes and other surfaces which are prone to contamination and thus, could minimize transmission of the infection. In this review, we have tried to project different strategies for upcoming research on antiviral materials using the nanotechnology platform.

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Note: Only key references have been mentioned here. For further references, kindly contact the authors.

Authors Information

1. Ganesh Srinivasan: He is currently working as CEO of Resil Chemicals Pvt. Ltd., Bangalore. He completed his B.Tech. in Rubber and Plastic Technology in 1992 from Anna University, Chennai. He has an experience of around 25 years in silicones, polyurethanes, car care formulations, textile finishing formulations and nanomaterials.

2. Kamlesh Panwar: She is currently working as Research Scientist in Resil Chemicals Pvt. Ltd., Bangalore. She has a background of M.Sc. in Chemistry, M.Tech. in Nanotechnology and completed her PhD from IIT Delhi in 2017. Her research area includes nanomaterials, Janus particles, functional textiles, phase change materials, flame retardant coatings, metal organic frameworks and polyurethanes.

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ASM INTERNATIONAL

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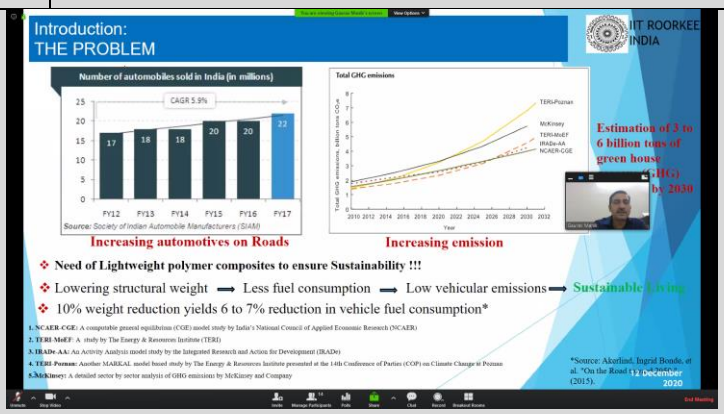
Calendar of Events

Technical Lecture / Talks

"Friction and Wear Evaluation of Materials using Smart Tribometers"	
Date / Venue	November 28, 2020 @ Ring Central Online Meeting Platform
Speaker / Programme	Mr. Anshuman Dube Ducom Instruments (HQ, Bangalore) – Director - Technology Ducom Aerospace – General Management Team & Lead - Space Technology Ducom Instruments Malaysia - Managing Director Ducom Labs - Business Head

"Development of Industrially Relevant High Specific-Strength Polymer Composites and Self-Clean Coatings"	
Date / Venue	December 12, 2020 @ Ring Central Online Meeting Platform
Speaker / Programme	Prof. Dr. Gaurav Manik Associate Professor, Department of Polymer and Processing Engineering IIT Roorkee, Roorkee, India



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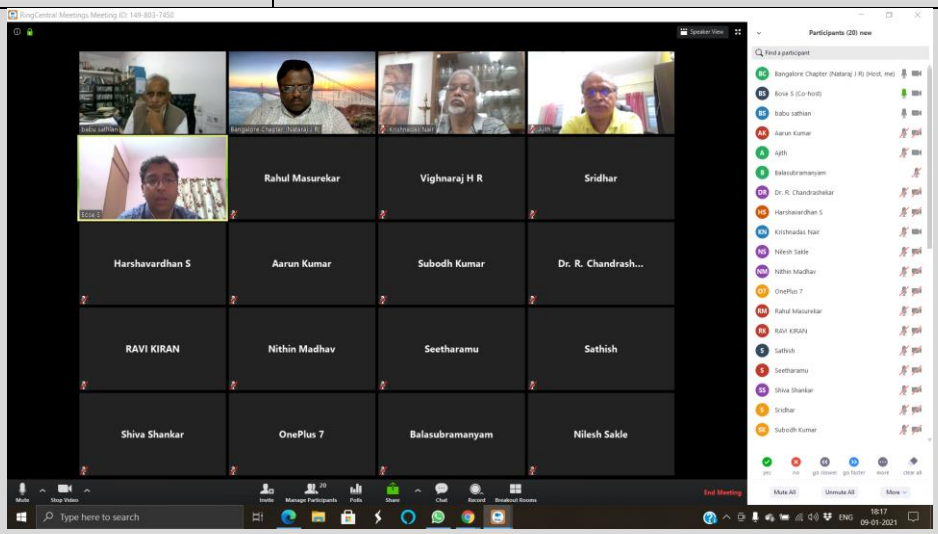
Technical Lecture / Talks

"Engineering Plastics – From an Application Standpoint"	
Date / Venue	January 9, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Prof. Dr. Suryasarathi Bose Associate Professor, Polymer Processing Group Department of Materials Engineering Indian Institute of Science Bangalore-560012



"Design Optimization of Aerospace Polymeric Sandwich Composites for Strength and Stiffness" (ASM-IIM Talk)	
Date / Venue	January 29, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Prof. Dr. Padmanabhan Krishnan FIIP, FIE, CE(I), SLFISME, FIA Struct E, FSIESRP Professor, School of Mechanical Engineering VIT-University Vellore, India, 632014

Bangalore Chapter – News Letter

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Events Calendar 2020-21

1. Memberships	Drive by Headquarter / India Task Force
2. Monthly Technical Talks	To improve consistency and Participation
3. Student Outreach	a) Events for Students – Talks + Industrial Visits b) Membership & Student Chapter Formation c) Support in Projects / Training d) Material Camps
4. Major Events	a) One/Two Days Workshops / Seminars b) Annual Get-together c) Annual General Body Meeting d) Hosting of INC Meeting / Visiting ASM Leaders e) Support to other ASM Chapters / Local Associations in their events.
5. Technical Talk	Every 2nd & 4th Saturday 5.00 pm if Webinar or Every 3rd Saturday 5.00 pm
6. Executive Council Meetings	This Qtr. – November 21, 2020 ; December 19, 2020 ; January 16, 2021

ASM International Bengaluru Chapter cordially welcomes the following New Members who have joined the chapter during the period – From 1st November 2020 to 31st January 2021:

Sl. No.	Names of New Members
1	**Mr Vijay Shrinivas** **M/s. Steer Engineering Pvt. Ltd.**
2	**Mr Nagabhushana Sastry** **M/s. Fibroheat Innovators Pvt Ltd.**
3	**Mr U Tejaswi** **M/s. Galvano Track Solutions Pvt. Ltd.**
4	**Mr Ramakrishna Ramu** **M/s. Faiveley Transport Rail Technology**
5	**Mr. Ajayaghosh Maniyan** **M/s. TCS**
6	**Prof. Praveen C Ramamurthy** **M/s. Indian Institute of Science**
7	**Dr Rajaratnam Chandrashekar** **M/s. Sambharam Institute of Technology**

ASM International -Bangalore Chapter

Visit www.asmblrchapter.com for more details about ASM Bangalore chapter and membership

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Please mail your valuable suggestions/comments to : asmblr2015@gmail.com